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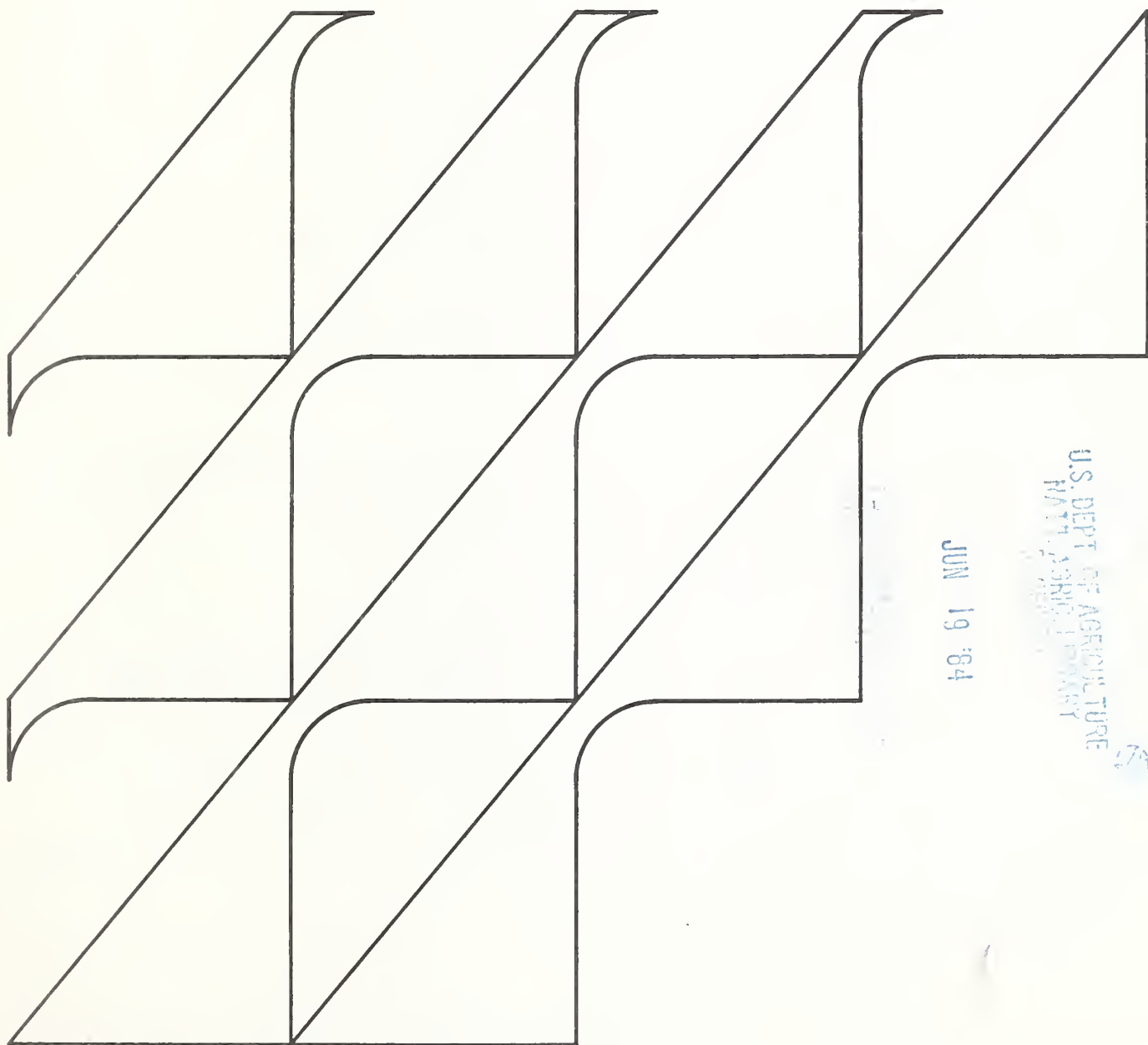
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# Long-Term Developments in Trade in Feeds and Livestock Products

Jim Longmire with Walter H. Gardiner



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LONG-TERM DEVELOPMENTS IN TRADE IN FEEDS AND LIVESTOCK PRODUCTS,  
by Jim Longmire as abridged and edited by Walter H. Gardiner,  
International Economics Division, Economic Research Service,  
U.S. Department of Agriculture, Foreign Agricultural Economic  
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#### ABSTRACT

International trade in feeds outpaced trade in livestock products during the 1970's, reflecting a trend toward greater domestic livestock production and the inability of some countries to keep feed production in line with demand. Trade in feeds, poultry, and dairy products grew faster in the 1970's than in the 1960's, while trade in red meats grew at a much slower pace. Long-term trade patterns will be influenced not only by technological advances for each commodity but also by trade policies, consumers' preferences, and cultural practices.

Keywords: Trade patterns, feeds, livestock products, comparative advantage, government policy, value added, trade liberalization.

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## SUMMARY

International trade in feeds outpaced trade in livestock products during the 1970's, reflecting a trend toward greater domestic livestock production. Trade in feed grains and protein meals grew rapidly in the 1970's as demands for feeds exceeded supplies in countries which expanded livestock production faster than feed production. The United States captured a large share of the expanding market for feeds in the 1970's but not without strong challenges from competing exporters.

The total trade in livestock products grew slightly faster in the 1970's than in the 1960's, but with mixed performance for individual livestock products. Trade in poultry and dairy products grew substantially faster during the 1970's than in the previous decade, while trade in red meats grew much more slowly. The United States and the European Community (EC) supplied the bulk of the increase in the poultry trade while the EC gained a large share of the dairy trade.

Long-term trade in feeds and poultry should continue growing at a more rapid pace than trade in red meats. Technological improvements are likely to be higher for feeds and poultry than for red meats, making imported feeds and poultry an attractive means for upgrading diets. The United States will remain a major exporter of feeds and poultry but will experience growing competition in these markets from other exporters.

Current international trade patterns in feed and livestock products are greatly influenced by such factors as domestic and trade policies, transportation costs, consumer preferences, and cultural traditions. Removing some of the artificial influences in the market place, especially trade barriers, would result in increased farm output in North America, Oceania, and Argentina, and possible export gains in developing nations.

In order to achieve these projections, several basic alterations in the international marketplace must take place:

- o National trade policies which serve as trade barriers must be liberalized.
- o The world economy must improve to allow for growth in the marketplace.
- o Technological advances must occur which will improve the efficiency of various processes which add value to agricultural commodities.





# Long-Term Developments in Trade in Feeds and Livestock Products

Jim Longmire with Walter H. Gardiner\*

## INTRODUCTION

In the past two decades, economic growth, changes in domestic and trade policies, and technological improvements in feed and livestock production have significantly shifted feed and livestock trading patterns. Eliminating trade barriers and price policy distortions would realign trading patterns to be more compatible with the concept of comparative advantage (16,17,26). 1/

The relative or comparative cost of a commodity is the basis for determining whether a nation has a comparative advantage in international trade. The relative cost, rather than the absolute cost, determines whether a nation is likely to export a particular product.

This paper analyzes some issues related to long-term shifts in trade in feed grains and livestock products, focusing on feed-livestock trade because of its importance to many agricultural sectors, particularly that of the United States. The following issues are addressed in this report:

- o To what extent has trade growth in unprocessed feed grains and high-protein feeds exceeded growth in products with more value-added content, notably meats?
- o Are the current world trade patterns in feed and livestock products compatible with the principle of comparative advantage?
- o Why are food-importing countries importing feed rather than livestock products?

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1/ Underscored numbers in parenthesis refer to items cited in the references section at the end of this report.

- o What are the effects of liberalizing trade?
- o Does the United States have a comparative advantage in the production of value-added products, or does this comparative advantage lie with the importing countries?
- o What are the long-term implications of shifting comparative advantage for trade in feeds and meats?

## SHIFTING TRADE PATTERNS

The trade patterns of feeds and livestock products have changed dramatically during the past two decades as a result of technical, institutional, and economic developments. Trade in feeds outpaced trade in livestock production during the 1970's, reflecting a trend toward greater local livestock production and the tendency for livestock production to expand faster than feed production in many countries. <sup>2/</sup> Trade in feeds grew at an annual rate of 8.3 percent during the 1970's, reaching 195.1 million tons feed grain equivalent (FGE) in 1980 (table 1). Trade in livestock products grew at a rate of 5.9 percent with a trade volume in 1980 of 105.5 million tons (FGE). Feeds' share of the total feed and livestock products trade increased from 60 percent in both 1960 and 1970 to 65 percent in 1980.

Trade in feed grains grew more than twice as fast in the 1970's as in the 1960's and dominated the world feed market in 1960 and again in 1980 with over half of the total volume traded. Trade in protein meals during the 1970's expanded at about the same rate as in the 1960's, accounting for over half of the total feed trade in 1970.

International trade in livestock products grew slightly faster during the 1970's than during the 1960's, but with mixed performance for individual products. Trade in poultry and dairy products grew substantially faster in the 1970's while trade in red meat, especially beef and sheep meat, grew substantially slower. Milk and dairy products accounted for over half the volume of livestock products trade in 1960 and 1980 while meat made up over half of livestock products trade in 1970.

## The Market for Feeds

The United States increased its dominance in the feed grain market over the past two decades with sharply larger net exports, especially during the 1970's (table 2). Australia also experienced a sharp increase in grain exports during this period

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<sup>2/</sup> In summarizing the aggregate changes in world trade in feeds and livestock products during the past two decades, all major livestock products, coarse grains, and high protein feeds (mainly oilseed meals) are expressed as feed grain equivalents (table 1). Trade in wheat for feed was not included because data are not available on wheat traded for feed purposes. About 90 percent of the wheat traded internationally is used for food purposes, but in Eastern Europe and the Soviet Union, imported wheat for flour milling frees domestic wheat for animal feeding. The exclusion of feed wheat, cereal brans, and nongrain feeds (such as manioc, corn gluten feed, and citrus pulp) understates the growth in feeds.

Table 1--Total world trade in livestock products and feeds, 1960-80 1/

Year	: Beef, : Sheep : Pork, : : Milk and : Total : : High- : Total : Ratio	: veal, and : meat and : bacon, : Poultry : All : dairy : livestock : Feed : protein : : feeds and : feeds	: canned : live : and ham : meat : meat : products 3/ : : grains : feeds : : livestock : to	: meat : sheep 2/ : : : : : : : : : : products : total								
	Million tons feed grain equivalents 4/											
1960	: 10.5	: 4.2	: 0.8	: 0.3	: 15.8	: 18.3	: 34.1	: 28.3	: 22.0	: 50.3	: 84.4	: 0.60
1970	: 20.3	: 7.2	: 1.8	: .7	: 30.0	: 29.2	: 59.2	: 42.9	: 45.3	: 88.1	: 147.3	: .60
1980	: 26.4	: 8.8	: 3.0	: 2.9	: 41.1	: 64.4	: 105.5	: 101.3	: 93.8	: 195.1	: 300.7	: .65
	Percentage change per year											
1960-70	: 6.8	: 5.5	: 9.0	: 7.9	: 6.6	: 4.8	: 5.7	: 4.3	: 7.5	: 5.8	: 5.7	: --
1970-80	: 2.7	: 2.0	: 5.3	: 15.7	: 3.2	: 8.2	: 5.9	: 9.0	: 7.6	: 8.3	: 7.4	: --
1960-80	: 4.7	: 3.8	: 7.2	: 11.8	: 4.9	: 6.5	: 5.8	: 6.6	: 7.5	: 7.0	: 6.6	: --

-- = Not applicable.

1/ Total world exports less exports between members of the 10 member nations of the European Community. Source: (7)

2/ Assuming 20 kg sheep meat per live sheep traded.

3/ Converted to wholemilk equivalent on the following basis (kg wholemilk equivalent to kg product): Evaporated and dried milk, 8.2; butter, 22.4; cheese, 7.5. Source: (28)

4/ Converted to feed grain equivalent on the following basis (ton feed grain equivalent per ton product): beef, 9.0; sheep meats, 8.0; pork, 4.9; poultry meat, 2.4.; high-protein feed, 2.0. Source: (6)

but still held a relatively small share of the market. Both the United States and Latin America (primarily Brazil) showed substantial growth in net exports of high-protein feeds (mostly soybean meal), with Latin America gaining a larger share of the market. The rapid increase in the feed trade is attributed to the expansion of the livestock industries in Western Europe, Asia, and the Eastern bloc (Eastern Europe and the Soviet Union) in response to higher demand for livestock products and the inability of feed production to keep pace with demand in these regions.

Japan and the Eastern bloc displayed the greatest growth in net imports of feeds from 1960 to 1980, with the Eastern bloc switching from a net exporter to a sizable importer. The European Community's (EC) <sup>3/</sup> policy of self-sufficiency in grains which enjoy high support prices and variable levy protection allowed the EC to reduce its dependence on imported feed grains by nearly half from 1960 to 1980. However, the fact that high-protein feeds are either permitted duty-free access or are taxed at a lower rate than imported grains sharply raised the level of high-protein feed imports over the same period. The EC has recently increased imports of nongrain feeds, notably manioc, which offset some of the decline in feed grain imports.

#### The Market for Live-stock Products

The world market for livestock products in 1980 was dominated by exports from Australia, New Zealand, and the EC with the United States, middle-income Asian countries, and the Eastern bloc as the dominant importers. Australia and New Zealand more than doubled their net exports of ruminant meats over the past two decades. The EC countries, which were the principal meat importers in 1960, replaced imported meats with domestic production during the 1970's, and were net exporters of poultry meat in 1980. The United States continued to lead the world in ruminant meat imports (principally beef) with a 164-percent increase from 1960 to 1980, although 1980 imports were off 3 percent from the 1970 level.

The most dramatic change occurred in the milk and dairy products market in which the EC shifted from a large trade deficit position to become the leading world supplier. This change reflects the EC's high support price policy and its goal for self-sufficiency in livestock products. Net exports from Australia and New Zealand, which grew 41 percent from 1960 to 1970, rose less than 2 percent more by 1980 and were less than half the level of EC's trade that year.

The United States registered a small positive balance in its dairy trade for 1980, with the volume just over a third of the 1960 level. The Eastern bloc switched from a small net exporter in 1960 to a major importer in 1980. Middle-income countries in Asia and Latin America also became major markets for dairy products during the 1960's and 1970's. These significant

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<sup>3/</sup> Refers to the 10 current member countries: Belgium, Denmark, Federal Republic of Germany, France, Greece, Ireland, Italy, Luxembourg, Netherlands, and the United Kingdom.

Table 2--Net exports of livestock products and feeds by region

Region/country	: Year	: Ruminant meats	: Pig and poultry meats	: Milk and dairy products	: Feed grains	: High-protein feeds	: Total
<u>Million ton feed grain equivalents</u>							
United States	: 1960	-2.54	0.20	1.88	13.01	8.08	20.62
	: 1970	-6.94	.15	1.15	19.20	27.27	40.83
	: 1980	-6.70	.74	.69	72.79	47.00	114.53
Canada	: 1960	-.05	.08	.39	1.84	-.06	2.20
	: 1970	-.44	.09	1.25	2.93	.38	4.22
	: 1980	-.19	.47	.82	2.92	1.13	5.15
Australia and New Zealand	: 1960	6.42	.02	7.69	1.58	0	15.71
	: 1970	9.59	.03	10.84	.91	-.04	21.33
	: 1980	13.26	.02	10.97	4.05	.07	28.36
European Community	: 1960	-6.77	-.29	-6.68	-13.81	-14.35	-41.90
	: 1970	-6.54	-.01	1.32	-13.81	-26.15	-45.19
	: 1980	-.39	.56	23.98	-6.95	-39.13	-21.93
Other Western Europe	: 1960	-.71	.03	1.79	-1.93	-.76	-1.58
	: 1970	-1.20	-.08	1.27	-3.82	-4.00	-7.83
	: 1980	.84	.18	.93	-.83	-6.58	-5.45
Japan	: 1960	-.19	-.03	-.44	-1.47	-1.90	-4.03
	: 1970	-1.11	.06	-.88	-10.88	-5.50	-18.32
	: 1980	-1.88	-.70	-1.79	-18.78	-8.55	-31.69
China	: 1960	.16	0	0	.13	.90	1.20
	: 1970	.18	.23	-.16	-.84	.49	-.10
	: 1980	.49	.35	-.67	-5.29	-.76	-5.88
Other Asia	: 1960	-.52	-.06	-7.09	-2.76	2.15	-8.28
	: 1970	-.70	-.40	-5.31	-.25	1.04	-5.62
	: 1980	-5.21	-1.35	-13.03	-7.30	-1.38	-28.27
Latin America	: 1960	4.00	-.05	-.80	2.43	4.75	10.33
	: 1970	7.05	-.15	-3.44	8.19	8.33	19.98
	: 1980	2.90	-.06	-5.95	-1.07	28.43	24.26
Africa	: 1960	.03	-.04	-1.06	-.07	2.99	1.84
	: 1970	.17	-.01	-2.91	.80	3.78	1.83
	: 1980	-1.19	-.22	-8.54	.27	2.14	-7.54
Eastern Europe and Soviet Union	: 1960	.35	.03	.10	6.43	-.96	5.94
	: 1970	-.17	-.31	1.10	-1.16	-8.23	-8.77
	: 1980	-1.17	.28	-5.53	-24.82	-15.99	-47.23

Sources: (6,7,28).



adjustments in trading patterns raise questions as to whether these changes are compatible with comparative advantage.

### The Comparative Advantage Issue

The concept of comparative advantage is based on the notion that a country will tend to export that commodity whose relative or comparative cost is lower than it is in other countries (21). Thus, relative or comparative cost rather than absolute cost is the basis for determining a country's comparative advantage in trade.

The traditional two-country, two-commodity model of comparative advantage (5, 9) can be extended to multicommodity cases. According to Caves, "The significance of comparative advantage in the many-commodity case is that a country must have a comparative advantage in every good it exports, compared to any good it imports" (4, p. 22).

The concept of comparative advantage can then be extended, with the same logic, to the case in which each value-adding process, such as feeding grains to livestock, can be considered a different product (22).

Comparative advantage, and, therefore, the patterns of trade, are based on the underlying characteristics of an economy--natural resources, labor force, infrastructure, technology, income level, and consumer tastes and preferences. Trade patterns can be altered by factors such as investments in human and physical capital, research and development, economic growth, migration, depletion or destruction of resources, weather fluctuations, business cycles, and government policy.

Changes in comparative advantage relate to a change in one or more of the structural characteristics of an economy. Therefore, changes in trade flows stemming from short-term climatic changes, business cycles, or government intervention should not be considered as changes in comparative advantage (25).

An aspect of the theory of comparative advantage that remains unclear is the interaction between government policy and a country's production possibilities and trade flows. There is little doubt that an economy's trade situation influences government policy. However, the reverse is also true. Economic policies can significantly influence a country's investment patterns, resource development, and technological adoption. It is therefore very difficult to separate the shifts in trade patterns due to a change in comparative advantage from those due to government policies.

### The Role of Technical Change

The technical efficiency of an economy defines the rate at which inputs are transformed into final products. Factors that influence technical efficiency in agriculture include the following:

- o Physical capital, such as equipment and machinery.

- o Human capital, such as knowledge, training, and skills of labor and managers.
- o Land quality and availability.
- o Environmental factors, such as weather, pestilence, and disease.
- o Biological inputs, such as high-yielding crops and hybrid livestock breeds.

Production processes which involve rapid turnover of inputs and which implement new research and development (R & D) are likely to have more rapid rates of technical improvement than those production processes involving less rapid turnover of inputs. Thus, crops are likely to profit from the rate of technical improvement more quickly than open-range livestock production. Similarly, animals with high reproductive rates and short breeding cycles such as broilers are likely to display more rapid genetic improvement than animals with longer biological cycles such as beef cattle.

Technologies can also be traded in the form of production inputs. These include tractors, combines, irrigation equipment, pesticides, hybrid seed, and livestock. The extent to which technology can be traded will depend upon the mobility of inputs in the production process, the ability of local inputs to combine with imported technology, the adaptability of imported technology to local conditions, and policy and institutional factors such as quarantine laws and the ownership of patent rights. In the feed-livestock economy, it seems reasonable to expect that technology associated with factory-like production processes (such as confined feeding operations) will be more readily traded than that associated with production processes involving extensive use of land and local labor.

#### The Nature of the Feed-Livestock Complex

The feed-livestock complex involves activities which add value to goods or commodities as they flow from producers to consumers. As the feed-livestock sector has become increasingly sophisticated, specialization and the number of value-adding activities have increased. The typical activities involved in the feed-livestock complex are:

- o Production of feed grains and oilseed crops.
- o Production of pasture and fodder crops.
- o Production of compound feed.
- o Production and maintenance of breeding livestock.
- o Production of livestock products and byproducts.
- o Marketing of feeds and livestock products.

When addressing issues of comparative advantage, it is useful to separate the value-adding processes because of different resource requirements for each of these activities and resource availability between countries (22). For example, production of breeding cattle and feeder cattle typically is a land-intensive activity, whereas meat processing typically is labor-intensive. It would be inaccurate to consider resource requirements for meats as a single unit when the requirements differ considerably for different value-adding processes. A country with a comparative advantage in production of feeder cattle will not necessarily have a comparative advantage in meat processing.

A key feature of the world feed-livestock economy is the trade in products with different degrees of value-added content. The bulk of this trade is in unprocessed commodities such as feed grains and oilseeds as well as processed oilseed meals and livestock products. A smaller, but far from insignificant trade occurs in formulated feeds, live animals, and byproducts of livestock and grain processing. A country may have a comparative advantage at one level of the market but not at another.

TRADE PATTERNS,  
TRADE LIBERALIZATION,  
AND COMPARATIVE  
ADVANTAGE

Trade patterns in agricultural products might change dramatically if all agricultural pricing policy distortions were removed (16, 17). Assessing the impact of this change is the same as assessing the compatibility of trade patterns with the concept of comparative advantage.

According to Johnson, removing price distortions would affect the world feed-livestock market in the following ways:

- o If consumer prices were at the levels that would be possible through free trade, food consumption would increase substantially, especially livestock products, in Europe and in Japan.
- o Livestock output would increase in Europe, largely based on cheaper grains, but probably not to the full extent of the increase in meat consumption, so that imports of meats would increase.
- o Farm output would increase in North America, Oceania, and Argentina, but this increase might not compensate for the reduced farm output in Europe and Japan, due to lower internal grain prices in these countries.
- o The developing countries of Asia, Africa, and Latin America could gain from expansion of export markets, so long as growth in domestic production was able to outpace growth in domestic consumption (16, 17).

In a more recent study, Tyers and Chisholm also addressed the issue of trade liberalization, with results generally supporting Johnson's findings (26). Using a demand-supply-price model that included food grains, feed grains, ruminant meats, and nonruminant meats for 15 regions of the world, the solution



under price-distorting policies that prevailed in the 1960's and 1970's was compared with the free-trade solution. Tyers and Chisholm predict significant shifts in world trade in feed grains and livestock products as a result of liberalizing trade (26):

- o U.S. net exports of feed grains would expand by some 6 million metric tons (mmt) and net exports of intensively fed livestock meats by 2.2 mmt, while net imports of beef would expand by around 1.3 mmt.
- o EC net imports of feed grains would increase more than 15 mmt, and net exports of meat from intensively fed animals would decline by 1.5 mmt from their projected level in 1985. 4/
- o Japan's net imports of feed grains would decline by 14 mmt, while net imports of beef and sheep meat would increase by 3 mmt and intensive meats by 1 mmt.
- o Oceania's net exports of beef and sheep meat would increase by 1 mmt.

These results suggest that removing trade barriers would significantly alter the pattern of trade in feed grains and livestock products. Meat trade would significantly increase and feed grain trade would generally decline. The results also suggest that the redistributive effects of policies are large. Total world welfare (as measured by aggregate economic surplus) would increase by \$50 billion (in 1970 terms) as a result of liberalizing trade, with Japanese and EC consumers gaining the most.

Thus, the results of these studies imply that the current trade patterns of feeds and livestock products are not compatible with the concept of comparative advantage.

#### COMPARATIVE ADVANTAGE OF THE UNITED STATES

The income and employment-generating effects of increasing the processed-product share of U.S. exports are significant (2, 24). For example, \$1 million of corn exported as grain is estimated to generate 147 jobs and \$1.4 million of personal income. If this corn were instead fed to poultry and the poultry were processed and exported, it would add an estimated 1,153 more jobs and \$9.3 million of personal income (24). These results raise the question of where the comparative advantage lies for the United States--in the production and export of bulk,

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4/ An increase in net exports of beef is predicted under free trade, suggesting that the effect of lower grain prices would more than offset the trade impact of lower beef prices in the EC. This was one point of difference between the argument of Johnson and the results of Tyers and Chisholm. Johnson argued that net export of beef from South America would fill the gap in beef consumption not filled by the growth in beef exports in Oceania. Tyers and Chisholm suggest that Latin America would be approximately self-sufficient in beef.

generally low-valued farm products or in the production and export of relatively high-valued processed products. This issue has considerable importance for policy decisions concerning the export strategies of the United States.

The United States clearly has a comparative advantage in the production of bulk products such as feed grains and soybeans. Climatic factors, combined with an economic environment conducive to investment and technological change in production and marketing facilities, are the sources of this comparative advantage.

However, it is less clear that the United States has a comparative advantage in processing raw materials into value-added products. It is possible that the comparative advantage of the United States in adding value to feeds through livestock production has declined against some major feed-importing countries. Some economies have experienced more rapid income growth than the United States in recent years, with higher rates of capital accumulation and gains in labor productivity. Japan, some European countries, and some of the rapidly industrializing countries of East Asia fall into this category. If these countries matched the rate of technical progress in the feed processing and intensively fed livestock sectors of the United States, then the comparative advantage in the value-adding processes probably moved in favor of those countries. 5/

In a number of other food-importing countries, the rate of technological progress in the feed-livestock economy did not keep pace with that of the United States. For these countries, comparative costs probably shifted in favor of the United States' exporting more intensively fed livestock products. 6/

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5/ Some interesting observations emerge from considering the direct costs of shipping meat. In the case of shipping poultry meat from the United States to the Middle East (Persian Gulf), recent quotes for shipping poultry meats from East Coast ports to the Persian Gulf ranged between \$350-\$500/metric ton. Comparative bulk grain freight rates were about \$42-\$52/metric ton (table 3). With a feed conversion efficiency in the United States of 2 kilograms (kg) feed per kg broiler meat, there would have to be cost savings of \$270-\$400/metric ton in the United States compared to the Middle East for it to be profitable to export poultry meat to the Persian Gulf, rather than shipping feed for poultry meat production. U.S. wholesale prices of broilers were about \$950-\$990/metric ton in the first quarter of 1982.

6/ The United States may have a comparative advantage in production of pig and poultry meat. This is indicated by the expansion of trade in pig meat and poultry meat exports from the United States in a free trade simulation. The expansion of beef imports under free trade suggests that the United States might not have a comparative advantage in beef production, at least in the kind of beef that dominates world trade (26).

For example, the feeding efficiency of Soviet livestock appears to have improved little over the past 20 years. Over the same period, the U.S. intensive-livestock sector has achieved considerable gains, with an average gain of 1.2 percent per year for poultry meat (27). Thus the United States probably has a comparative advantage in exporting value-added products to the Soviet Union, even though trade between these two countries has traditionally been in feed grains.

The policy of encouraging or discouraging feed versus livestock-product exports from the United States needs to be based on more than employment or income generation. It is important to assess the costs to the United States of encouraging resources into the value-adding sector and presumably away from more cost-effective deployment elsewhere in the economy.

There are also international implications to consider. Presumably, for every job created in the United States by adding value to feed, there is at least one job lost in the importing country. Income issues in the importing country then arise.

The wider benefits and costs of any policies that encourage greater processing of feeds into livestock products must be considered, and further analysis needs to be done on this issue.

#### IMPORTING FEED VERSUS IMPORTING MEAT

A number of elements influence policymakers in deciding whether countries ought to import feeds and then add value by feeding it to livestock or whether they ought to import meats. Many of these elements might be considered political or noneconomic. Other factors relate to consumers' tastes and local customs (1, 11, 18).

A primary reason countries prefer to import feed and to produce meats domestically from the feed is the quality of and the preference for the local product. Whereas feeds can be transported and stored at local temperature for a long time without undue quality deterioration, meats must be refrigerated and can be stored for only a relatively short time before quality deteriorates. If consumers prefer locally produced items as well as fresh meats to frozen meats and if there is a lack of refrigeration, an incentive will exist to import the feed and add value to it by feeding it to livestock. The relevant opportunity cost of this decision is either the cost of importing fresh meat or the cost of importing livestock and feeding it domestically.

Ocean transport costs do not appear to favor importing grains and feeding livestock over importing meat directly (table 3). The variability of ocean freight rates, notably in the bulk carrier market, can shift these comparative costs considerably.

Shipping livestock has become more competitive in certain markets, notably the shipment of live sheep from Australia to the Middle East. In this case, limited refrigerated meat-handling facilities in the Middle East and cultural and

Table 3--Comparative ocean freight rates for shipping  
grains and frozen meat in cartons

Item	From U.S. (Gulf ports) to--			From Australia to--	
	Japan	Middle East	Rotterdam	Japan	Middle East
	<u>Dollars per ton (actual weight basis)</u>				
Grain <u>1/</u>	26	33	10	26	33
Frozen meat in cartons <u>2/</u>	300	340	200	290	480
	<u>Feed grain equivalent basis</u>				
Bone-in frozen meat <u>3/</u>	33	37	22	32	53
Boneless frozen meat <u>4/</u>	22	24	14	22	35

1/ From International Wheat Council, Market Report, PMR 107, Appendix 2, London, 1982.

2/ Quotations for the United States obtained from Sealand Shipping Co., New Orleans, May 1982. Rates for Australia taken from Australian Meat and Livestock Corporation (1981), Annual Report, Sydney, 1981.

3/ Assuming 9 tons of feed grains converts to 1 ton of bone-in meat.

4/ Assuming yield of boneless meat to carcass equals 66 percent.

religious practices have encouraged major trade growth in live animals for slaughter. This is despite the fact that processing meat in Australia and transporting the frozen or chilled carcass is less expensive than importing live animals, at least on a cost-insurance-freight (c.i.f.) basis.

A second reason countries prefer to import grains rather than meats is to support the domestic livestock industry. This preference is demonstrated in Japanese and European policies (1, 10).

Countries also prefer to import feed rather than meat because the domestic meat supplies give a greater degree of security to the importing country. An importing country that is wary of food security risks may hesitate to specialize in a product in which it has a comparative advantage and instead diversify production patterns and lower trade levels (15). Having a reserve of feed grains and other feeds as well as livestock in feedlots or fattening houses offers a greater amount of food in reserve than simply importing meat directly.

In the event of an international disruption of food supplies, importers with normal commercial feed reserves and ongoing livestock production are likely to have more options than



countries importing meat directly. For example, livestock slaughter might be stepped up or feeding rates might be reduced, as appears to be the Soviet Union's response to its shortage of feed grains (29). Probably the most significant factor, however, is the wide range of feed ingredients that can be used in formulated feeds. Importers are likely to perceive greater security of food supplies when they have the option of processing a relatively wide range of feeds of various nutritional makeup and combining them through least-cost feed formulation procedures. Also, reserves of grains and other feeds are generally larger than reserves of livestock products, which are more expensive to store under refrigeration and are subject to quality deterioration.

The income- and employment-generating effects of importing feeds and raising livestock could be a significant factor in a preference for feeds rather than meats. When an economy places job creation as a high priority, there will probably be a preference for importing feed versus meats. In developing countries, the employment opportunities exist in constructing and operating feed processing units, livestock product units, and meat processing units. International trading companies generally make capital and skilled advice available for these purposes, so many developing countries have preferred to import feed and raise their own livestock.

Ultimately, the question of importing feeds versus meats becomes one of comparative costs. These comparative costs, however, need to be within the context of overall economic growth and development. With the relatively straightforward industrial technology involved, feed milling and intensive livestock production are likely to be high on the plans of developing economies that are increasing their level of meat and dairy product consumption.

## CONCLUSIONS

The relatively slow growth of trade in red meats in the 1970's, compared with growth in feeds and poultry meat, poses a question for future trade in red meats: Can we expect trade in red meats to continue expanding more slowly than trade in feeds and poultry meat?

A number of factors will dominate short-term trade in feeds and meats--economic recovery, the size of livestock populations, input price movements, interest rates, and the size of world harvests. Underlying these factors, however, are long-term developments that need to be considered.

First, the income elasticity of demand for poultry meat generally appears to be as high worldwide as that for beef, and generally above that of other meats (20).

Second, the rate of technological improvement in production of feeds and poultry meat is likely to be higher than for red meats. This is likely because of the shorter life cycles of fowl and grains and the possibility for more rapid genetic improvement in production of crops and broilers, as well as the

possibility for more rapid adoption of technologies in these industries. New developments in genetics research have the potential to increase the rate of genetic improvement in livestock, but those animals' much slower reproductive rates and longer breeding and growth cycles suggest that this rate is unlikely to match that of crops and broilers.

These two factors combined suggest that world consumption of poultry meat is likely to grow more rapidly than consumption of red meat. The costs of producing meat from feed will probably set the level of meat prices over the long term. This factor, combined with the importance of grain-fed meats in the overall meat market, suggest that long-term feed costs will be a key factor in meat prices (20). If so, poultry meat prices can be expected to continue to decline relative to other meats. 7/

The expected consumption growth for poultry meat can be met from three sources:

- o Poultry meat imports.
- o Domestically produced poultry meat primarily from domestic feed.
- o Domestically produced poultry meat primarily from imported feed.

The direction of trade in poultry meat and feeds will be strongly influenced by the relative costs of the alternative strategies and government policies distorting these strategies. Along with policy changes, two factors will be important:

- o Relative rates of investment and technological change in grain and oilseed production.
- o Relative rates of investment and technological change in broiler production.

No information is available on relative rates of investment in grain and broiler production worldwide, except as indicated by crop area shifts and poultry statistics over the past few years. These data suggest that the rate of investment has possibly been more rapid in broiler production than in grains. It seems reasonable to assume that the rate of investment in broiler production will exceed that in grain production in the next decade, just as it did in the past two decades.

Technical advances in broiler production will likely be transferred more readily between countries than the technical advances in crop production. If this is so, the efficiency of

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7/ Over 1960-80, for example, the ratio of poultry meat to beef prices fell by an average 2.3 percent per year. While these relative price shifts will not necessarily continue at the same pace, the direction of price movement seems likely to continue.

broiler production will advance more in countries currently lacking the production technology of the major poultry meat exporters (United States, EC, and Brazil). These exporters' current comparative advantage in production could erode over time; if that comes about, trade in feed might outpace trade in poultry meats.

One factor that might, over the long term, slow the growth rate of feed exports relative to meats would be a more rapid expansion of feed grain and oilseed production in food-importing countries. In particular, any changes in the incentive system that favor an expansion of crop production, notably in the Soviet Union and Eastern Europe, could have a significant effect on world trade in feed grains and oilseeds.

Prospects for trade in red meats hinge on the relative price of grains to meats and on the policy actions taken in many meat-trading or potential meat-trading countries. Since the bulk of international beef trade is grass-fed beef, long-term prospects for trade in beef hinge upon longer term prospects for comparative advantage of rangeland beef. Feed productivity gains in feedlot beef production will probably outstrip those of grazing cattle, due to the greater control feedlot managers have over feed intake than do ranchers. Rangeland beef production, however, may have a greater chance for productivity gains in use of labor, purchased inputs, and energy-intensive inputs. This suggests that the comparative advantage between feedlot beef and rangeland beef could shift either way, and that patterns of trade in beef will be primarily influenced by policy decisions, short-term fluctuations in grain prices, rates of economic growth, and demand shifts between various qualities of beef.

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Although one can measure international trade in such a way as to determine a nation's comparative advantage in one or more commodities, there is a need for further research using more sophisticated methods than are currently available. For example, using current economic theories, certain assumptions were necessary in developing this paper. However, those assumptions raise questions about the validity of applying basic economic theories to complex international trade issues.

One of the prime concerns is the time dimension of comparative costs. While the theory of trade is often related to the long term in a static framework, many of the issues of growth and change might best be treated in a shorter time frame. This is particularly so for livestock where short-run negative-supply responses complicate the theory of trade. <sup>1/</sup>

Another area of concern in the application of trade theory to real world issues is the influence of policy interventions. There is a need for more information on the nature and extent of distortion of the feed and livestock markets. While considerable information is available about the various interventions in many countries, there remains plenty of room for comparing the effect of these distortions internationally and across economic sectors. Studies of the Industries Assistance Commission in Australia (12) and by Harling (10) emphasize the importance of measuring effective rates of protection.

Some of the difficulties in measuring effective rates of protection include the following:

- o The lagged supply response in livestock production due to the length of the biological cycle.
- o The division of the world beef market into zones free of and infected with hoof-and-mouth disease.
- o The extent of nontariff barriers such as quality standards, labeling laws, sanitary regulations, veterinary requirements, and quarantine restrictions.

A lack of basic information restricts the use of trade theory in the feed-livestock sector. There is a general lack of information about rates of productivity growth and technological change in agriculture. In a cursory review of the literature, very few studies appear to address this fairly fundamental issue for agriculture, particularly during the 1970's. Economists' understanding of technological change and productivity growth in agriculture overall has improved little in the past decade, and this lack of understanding severely limits our ability to make

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<sup>1/</sup> Incentives to expand production, such as, higher expected livestock prices, result in short-run contraction in market supplies as producers build-up herds, while incentives to cut back, such as, lower expected livestock prices, result in short-run increase in supplies as producers reduce herd size.

long-term projections about production and consumption of food. Comparisons of a number of countries as well as world regions, perhaps broken down in more detail than the recent work of Gollop and Jorgenson (8), would be very useful.

Despite these concerns, there is tremendous room for further analysis of policy and trade in the feed-livestock economy. Issues of optimal location, changing industry structure, policy effects on trade and prices, determinants of trade, interregional effects, technological change, technology transfer, and so on, still need to be analyzed in detail. Other issues of importance include the extent to which policies have altered investment, technological change, and production in particular agricultural sectors.

Another issue needing further analysis is the preference for importing feeds rather than meats. This issue can be addressed from a number of angles. Work along the lines of Pearson and Meyer (19) would be a valuable contribution, but more extensive use of input-output tables and mathematical programming models would be necessary to measure properly the alternative opportunity costs involved.

Considerable scope exists for the application of quantitative models to trade and policy issues concerning the world feed-livestock economy. However, the models employed will have to be much more sophisticated in the way investment, technological change, demand shifts, and structural changes interact with policies than is currently available (26).

APPENDIX B -- RECOM-  
MENDED ADDITIONAL  
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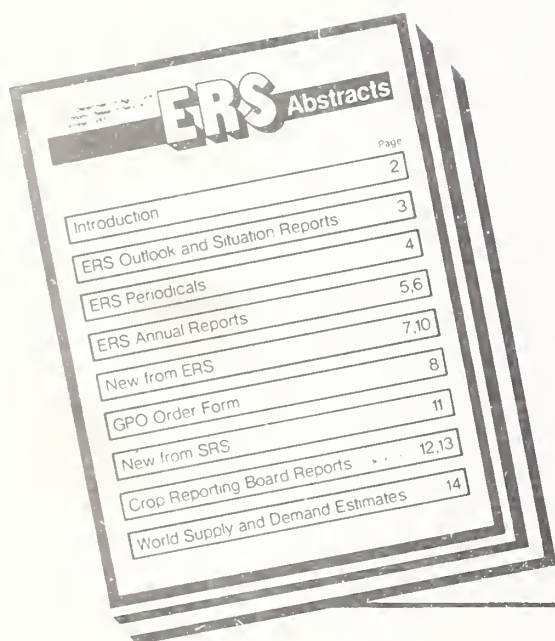
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